Space Weather Technical Forecast

Issued on Tuesday, 28 June 2022 at 13:16 Local

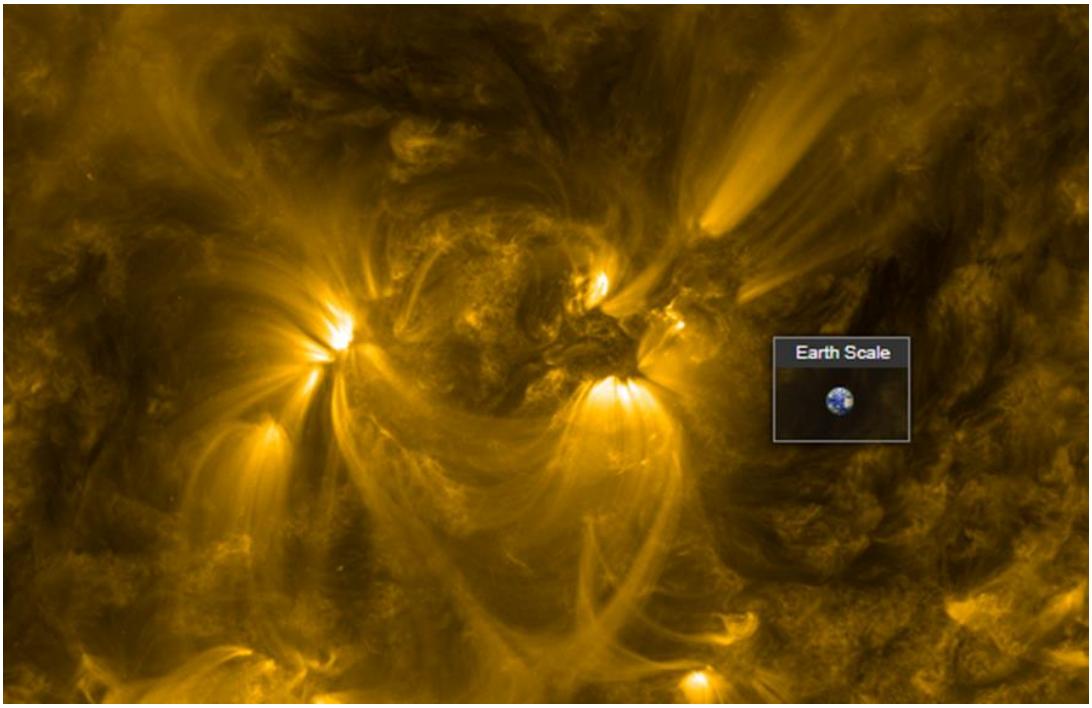
This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Active electron fluence continuing. Slight chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with one small C-class flare observed. There are five sunspot regions on the visible disc, three of which are unnumbered. AR3040 is currently the largest region and is still developing, now Dao/Beta-Gamma. It remains moderately large with an asymmetrical lead spot but does not look magnetically complex on satellite imagery. AR3041, near the northwest limb, also contains an asymmetric lead spot so is reassigned as a Cao/Beta group. A new region has developed to the north of AR3040. It is currently a small bipolar region, albeit growing rapidly, one of the spots displaying a small penumbra. The two other new regions, in the southeast quadrant, are both small and simple Bxo/Beta.

Figure 0: Recent Helioviewer-generated image from SDO/AIA 171, showing the relative magnetic simplicity of AR3040. Earth for scale.



There are considered to be no new Earth-directed CMEs showing on available imagery. The SDO outage is now over but it'll take a while for the data to back-fill the gaps, meaning there is still a possibility for weak transient features to be embedded in the solar wind.

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Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR and ACE at L1, was largely elevated, between 500-570 km/s, suggesting the influence of a coronal hole high speed stream. Density was average. The Phi angle was predominately negative (towards the Sun). The total Interplanetary Magnetic Field (IMF) was weak and below 6nT, the North-South component, Bz, fluctuating between +/-5nT. The resulting geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) as measured by GOES16 remained at Background levels throughout the period. The High energy electron flux (greater than 2MeV) remained at high levels over the last 24 hours, reaching a peak of 3640 pfu at 27/1610 UTC. The corresponding 24-hour electron fluence rose above the Active threshold (1e8 integrated pfu) from 27/1500 UTC, reaching a peak of 2.15e8 integrated pfu at 28/0900 UTC. An observed fluence of 1.54e8 integrated pfu was recorded at 28/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low, with only a slight chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A CME that left the Sun on the 24th was signalled to perhaps give a glancing blow in the early UTC hours of the 28th but it most likely passed ahead of Earth. No other earth-directed CMEs currently feature in this forecast. Solar winds are expected to slowly come back to slow-ambient levels over the next 2 or 3 days as the influence from CH93 and CH94 wanes, with no further significant enhancements expected. Geomagnetic activity is therefore expected to be mainly Quiet with isolated Unsettled intervals through this period.

Energetic Particles / Solar Radiation: In the absence of any significant sunspot development, the High energy proton flux (greater than 10 MeV) is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) is expected to continue at mainly High levels until at least day 3 (30th), thereafter a drop in electron flux to more persistently Moderate or Background levels appears probable. Corresponding electron fluence is expected to remain above the Active (1e8 integrated pfu) fluence level until at least day 3. After this it may lower to Moderate levels, though confidence in this aspect is fairly low.

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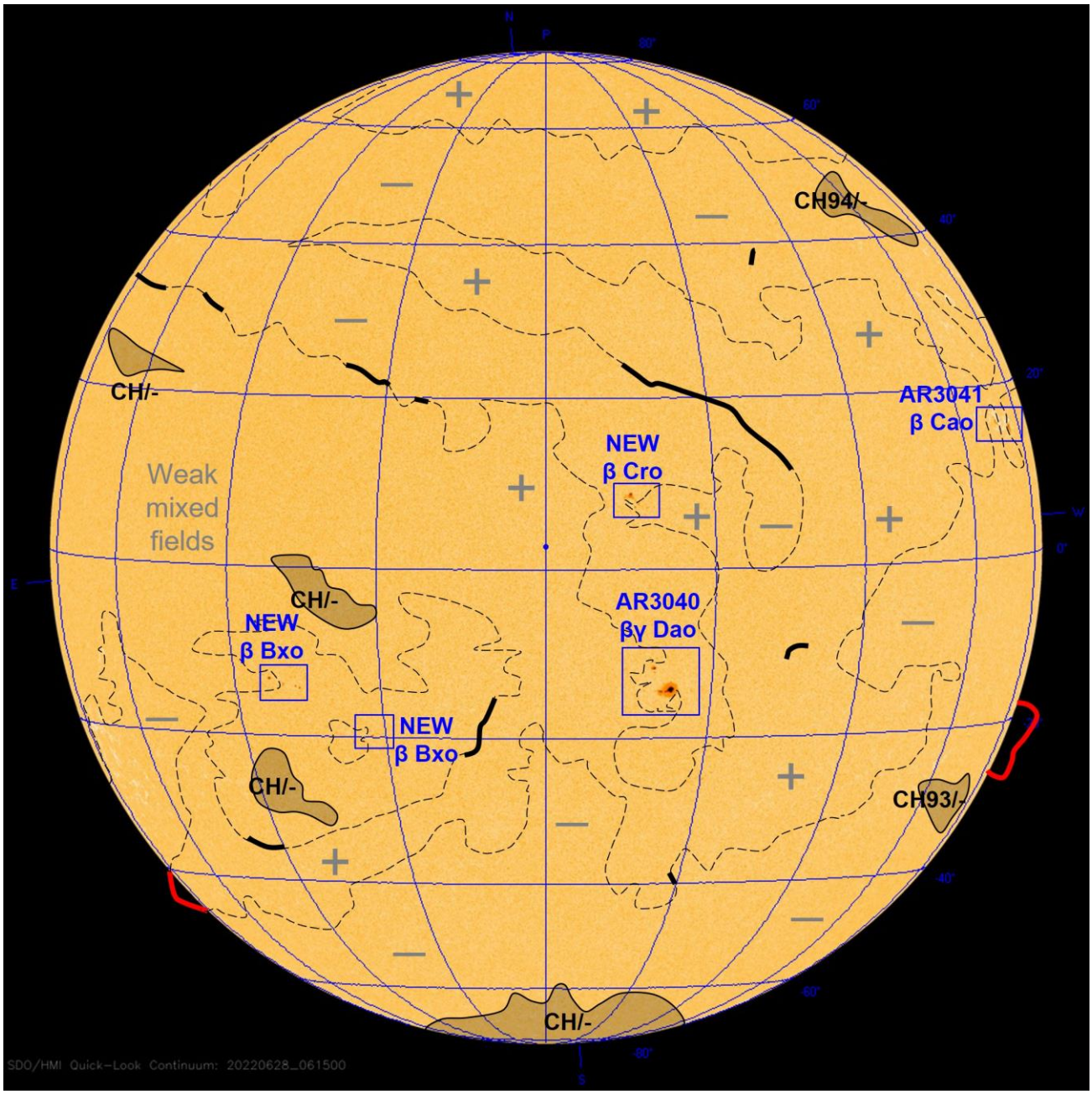
Figure 1. Solar Analysis Valid 28/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A filament eruption was observed leaving the sun on the 24th, followed by a weak CME that was visible on STEREO A cor2 imagery. This was assessed as passing just ahead of Earth with a slight chance of a glancing interaction in the early UTC hours of the 28th but the risk is now considered more and more unlikely. No other Earth-directed CMEs have been observed on satellite imagery.

With Coronal holes 93 and 94 now approaching the western limb and no other features visible on the western hemisphere, solar winds should initiate a slow decline and come back towards slow-ambient levels over the next two or three days. Geomagnetic activity is therefore expected to be mainly Quiet with isolated Unsettled intervals through this period.

There is a large filament on the western hemisphere. It is currently stable but will need to be monitored for any potential lift off.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL.

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Radio Blackouts - X-Ray Flares:
There are five sunspot regions on the visible disc, three of which are unnumbered. AR3040 is currently the largest region and is still developing, now Dao/Beta-Gamma. It remains moderately large with an asymmetrical lead spot but does not look magnetically complex on satellite imagery. AR3041, near the northwest limb, also contains an asymmetric lead spot so is reassigned as a Cao/Beta group. A new region has developed to the north of AR3040. It is currently a small bipolar region but that seems to be growing rapidly, one of the spots displaying a small penumbra. The two other new regions, in the southeast quadrant, are both small and simple Bxo/Beta.

Solar activity has been Low over the past 24 hours. The figures have been revised slightly upward, due to the recent development of new regions, but activity is expected to remain Low, with only a slight chance of isolated M-flares.
A bright flux region is visible on STEREO-EUVI imagery (around 120 East), perhaps indicating the presence of an active region although none are expected to rotate onto the Earth-facing disc in the next three days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2: Recent HMI Intensitygram (left) and Magnetogram (right) of AR3040, currently the largest and most complex region on the visible disc.

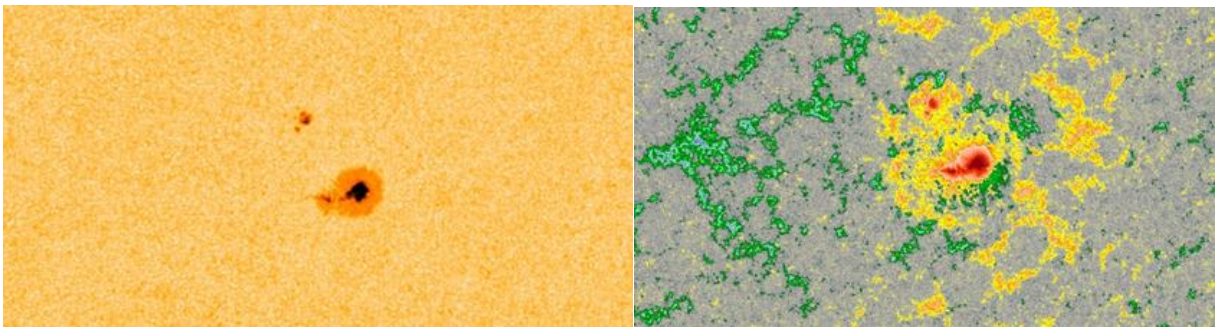

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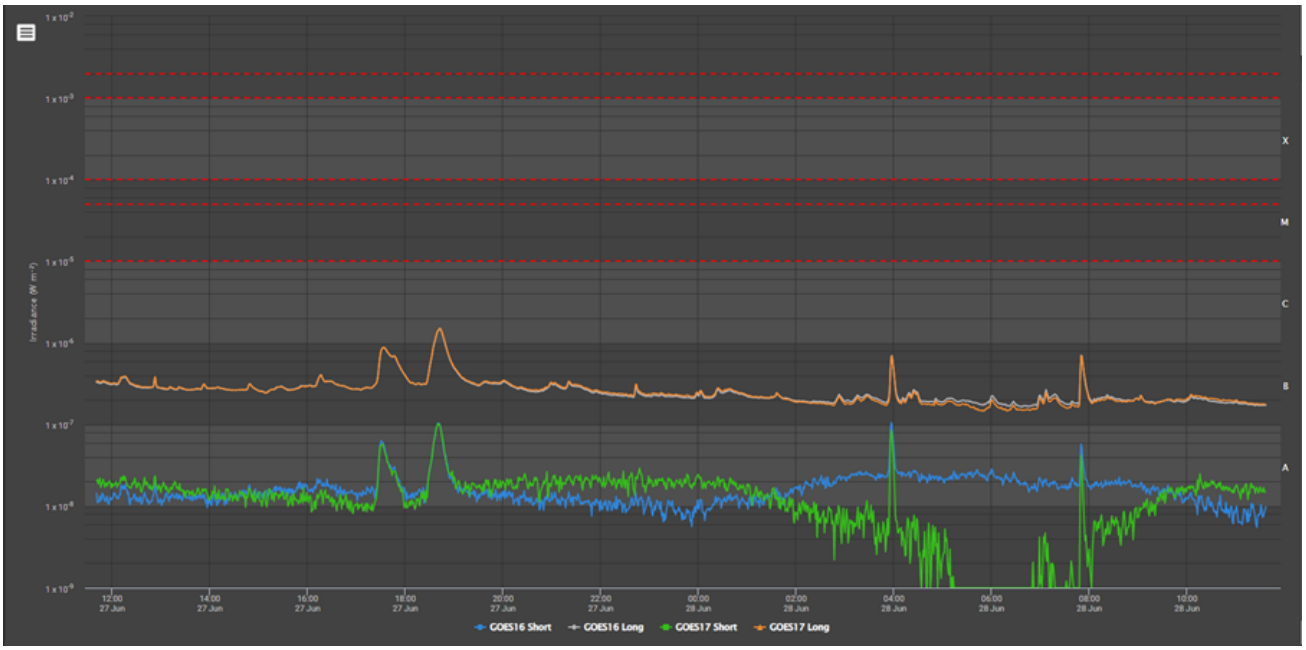
Figure 3: Latest GOES-16 X-Ray flux



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and will most likely remain at this level through the period, in the absence of any significant sunspot development.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux, as observed by GOES-16, remained at High levels throughout this period.

Electron flux levels are expected to continue at mainly High levels until at least day 3 (30th), thereafter a drop in electron flux to more persistently Moderate or Background levels appears probable. Any CME glance that occurs early on day 1 (28th) may temporarily lead to a drop out in values, however this is very low confidence and only has a slight chance of occurring.

Corresponding electron fluence is expected to remain above the Active (1e8 integrated pfu) fluence level until at least day 3. After this it may lower to Moderate levels, though confidence in this aspect is fairly low. Active levels of fluence were observed around 24 hours later than standard 27-day persistence had indicated, though this and the REFM forecast indicate fluence levels remaining above the Active threshold well into day 3. This gives added confidence to the current forecast.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	90	80	50

Figure 4: Latest GOES-16 High Energy Electron flux

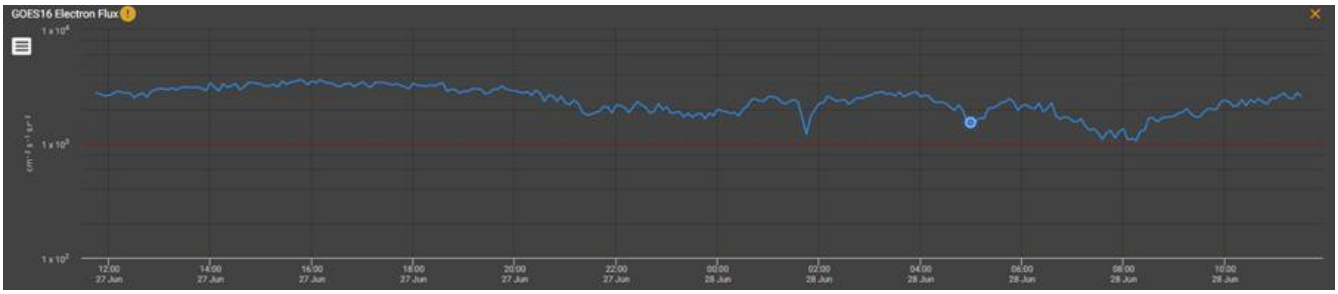

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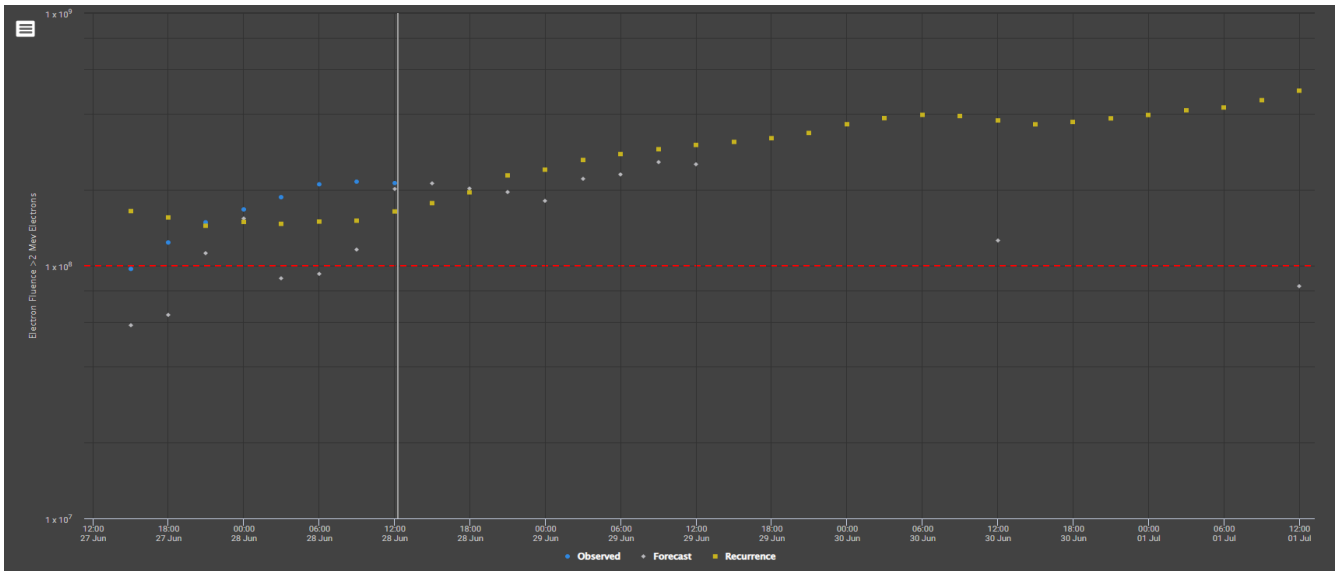
Figure 5: Latest REFM output



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